IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Inventor(s):	Katherine H. Guo et al.	**Serial No.:**	10/772,080
Case:	Guo 11-7-35-12 (ALU/125275CIP)	**Filed:**	02/04/2004
Examiner:	Chambers, Tangela T	**Group Art Unit:**	2617

Confirmation #: 4523

Title: BANDWIDTH GUARANTEED PROVISIONING IN NETWORK-BASED MOBILE VIRTUAL PRIVATE NETWORK (VPN) SERVICES

MAIL STOP APPEAL BRIEF-PATENTS
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

SIR:

APPEAL BRIEF

Appellants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 2617 mailed June 19, 2009 rejecting claims 1-5, 11-15 and 21-22.

In the event that an extension of time is required for this appeal brief to be considered timely, and a petition therefor does not otherwise accompany this appeal brief, any necessary extension of time is hereby petitioned for.

The $540 Appeal Brief fee is being paid with the EFS Web submission of this Appeal Brief. Appellants do not believe that any other fees are due. In the event Appellants are incorrect, the Commissioner is authorized to charge any other fees to Deposit Account No. 50-4802/**ALU/125275CIP**.

Table of Contents

Real Party in Interest

The real party in interest is Alcatel Lucent.

Related Appeals and Interferences

Appellants assert that no appeals or interferences are known to Appellants, Appellants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 1-22 are pending in the application. Claims 1-22 were originally presented in the application. Claims 1, 11-20 and 22 have been amended. Claims 6-10 and 16-20 are objected to as being dependent upon a rejected independent claim. The rejection of claims 1-5, 11-15, 21 and 22 is appealed.

Status of Amendments

All claim amendments have been entered.

Summary of Claimed Subject Matter

Embodiments of the present invention are generally directed to a method and apparatus for optimally provisioning connectivity in network-based mobile virtual private network (VPN) services. The apparatus includes provisioning each of a plurality of IP service gateways (IPSGs) to support virtual private network (VPN) tunneling between customer premise equipment of a subset of VPN customers and at least one mobile access point (MAP). The MAPs are geographically remote from the plurality of IPSGs, and each of the MAPs support VPN tunneling to mobile nodes of the subset of VPN customers.

In one embodiment, a first method includes for each customer, selecting a subset of IPSGs to maximize total profit resulting from provisioning the customers on the selected IPSGs, wherein the total profit from all the customers comprises the sum of profits from each customer, where for each customer profit (G) equals weighted revenue less cost. The weighted revenue includes revenue and a relative weight factor γ on

revenue compared to cost, where γ allows a network service provider to adjust price based on cost of the customer. Further, the cost per customer comprises a total tunnel connection cost from the MAP to the CPE, and a current cost of provisioning an IPSG node, wherein the total tunnel connection cost comprises a dynamic tunnel connection cost between the MAP and the provisioned IPSG, and a static tunnel connection cost between the provisioned IPSG and the CPE.

In a second embodiment, a method and virtual private network (VPN) system architecture is provided for providing bandwidth guaranteed provisioning in network-based mobile VPN services. The method and system architecture include identifying a set of VPN customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one IP service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each MAP is geographically remote from each IPSG. A subset of IPSGs is selected to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs. Total profit from all the customers includes the sum of profits from each customer (l), where for each customer, profit (U^l) equals weighted revenue (γV^l) less cost (C^l) ($U^l = \gamma V^l - C^l$), wherein the cost per customer includes a total tunnel bandwidth cost (C^l_C) from the MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node.

For the convenience of the Board of Patent Appeals and Interferences, Appellants' independent claims 1, 11 and 22 are presented below with citations to various figures and appropriate citations to at least one portion of the specification for elements of the appealed claims.

Claim 1 recites (with references to illustrative portions of the specification added):

> 1. (Previously Presented) A method (FIG. 3, FIG. 5, FIG. 7, FIG. 9) comprising:
>
> identifying a set of virtual private network (VPN) customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one

Internet Protocol (IP) service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each MAP is geographically remote from each IPSG; and (Pg. 11:20-Pg. 12:5; Pg. 15:14-20; FIG. 5, 502)

selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node. (Pg. 12:6-21; Pg. 15:21-Pg. 16-33).

Claim 11 recites (with references to illustrative portions of the specification added):

11. (Previously Presented) A virtual private network (VPN) system architecture, comprising: (FIG. 2)

means for identifying a set of virtual private network (VPN) customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one Internet Protocol (IP) service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each MAP is geographically remote from each IPSG; and (Pg. 8:8-Pg. 11:19; Pg. 11:20-Pg. 12:5; Pg. 15:14-20; FIG. 2)

means for selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said

MAP to said CPE, and a cost ($C^l{}_V$) of provisioning an IPSG node. (Pg. 8:8-Pg. 11:19; Pg. 12:6-21; Pg. 15:21-Pg. 16-33; FIG. 2).

Claim 22 recites (with references to illustrative portions of the specification added):

22. (Previously Presented) A computer readable medium for storing instructions that, when executed by a processor, perform a method for optimally provisioning connectivity for network-based mobile virtual private network (VPN) services, comprising: (FIG. 2; Pg. 8:8-Pg. 11:19)

identifying a set of virtual private network (VPN) customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one Internet Protocol (IP) service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each said MAP is geographically remote from each said IPSG; and (Pg. 11:20-Pg. 12:5; Pg. 15:14-20; FIG. 5, 502)

selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue ($\gamma\, V^l$) less cost (C^l) ($U^l = \gamma\, V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost ($C^l{}_C$) from said MAP to said CPE, and a cost ($C^l{}_V$) of provisioning an IPSG node. (Pg. 8:8-Pg. 11:19; Pg. 12:6-21; Pg. 15:21-Pg. 16-33; FIG. 2).

Grounds of Rejection to be Reviewed on Appeal

Claims 1 – 5, 11 – 15, and 21 – 22 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lor et al. U.S. Patent Publication No. 2004/0068668 A1 (hereinafter "Lor"), in view of Zargham et al., U.S. Patent Publication No. 2003/0229613 A1 (hereinafter "Zargham").

ARGUMENTS

I. Rejection of claims 1-5, 11-15 and 21-22.

Claims 1 – 5, 11 – 15 and 21 – 22 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lor in view of Zargham.

A.1. Claim 1.

Claim 1 is rejected under 35 U.S.C. §103(a) as being unpatentable over Lor in view of Zargham. Appellants urge to the contrary.

1. *The Examiner failed to establish a prima facie showing of obviousness because Lor and Zargham alone or in combination fail to teach or suggest all the claim elements.*

A *prima facie* case of obviousness has not been established because the combination of Lor and Zargham does not teach or suggest all the claim elements. More specifically, Lor and Zargham, alone or in combination, fail to teach or suggest at least:

> "selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (${}^\gamma V^l$) less cost (C^l), ($U^l = {}^\gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node," as recited in Appellants' claim 1 (emphasis added).

The Examiner suggests that Lor teaches selecting a subset of IPGs to maximize total profit resulting from provisioning VPN customers on the selected IPSGs because Lor describes centralized load balancing performed by a load balancing manager collocated with a WLAN switch (equated with Appellants' IPSG) and providing cheap multi-vendor support. In particular, the Examiner asserts that providing cheap multi-vendor support inherently maximizes profit. The Examiner also states that Lor does not disclose specific relationships that are used to maximize the profit; but asserts that such relationships are obvious in view of Zargham. Appellants respectfully disagree.

More specifically, with respect to cheap multi-vendor support, Lor describes:

> "Also important is multi-vendor support, where the switch can unify upstream management info into the central manager and distribute downstream info in a vendor-specific fashion, thus providing simple, cheap multi-vendor support"

Lor, paragraph [0104]. However, Lor does not discuss or mention profit or maximizing profit in this description. In fact, nowhere in the disclosure does Lor even mention the term "profit."

Moreover, maximized profit, and maximized total profit resulting from provisioning VPN customers on selected IPSGs in particular, is not inherent from the cheap multi-vendor support. In particular, cheap multi-vendor support may result in reduced expenses compared to a more expensive multi-vendor support. However, Lor does not describe providing of cheap multi-vendor support as a goal of its arrangement, and Lor's description does not prevent existence of cheaper multi-vendor support arrangements. Furthermore, suggesting that expenses for providing multi-vendor support may be reduced falls short of teaching to maximize the profit, as required by Appellants' claim 1. Even assuming that reducing expenses causes increasing of profit, such a profit is not necessarily maximized, and thus, maximizing profit is not inherent from teaching of cheap multi-vendor support.

2. *Lor does not teach or suggest selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs*.

Moreover, as described by Lor, cheap multi-vendor support results from providing a single switch that unifies upstream management info and distributes downstream info in a vendor-specific fashion. Assuming *arguendo* that Lor's switch may be interpreted as Appellants' IPSG, Lor still fails to teach the above recited features of claim 1 because providing or using a switch of certain characteristics, as described in Lor, is different from selecting a subset of switches, as required by Appellants' claim 1. The Examiner's arguments fail to explain how or why the selection process is taught by Lor or obvious based on the teachings of Lor. Furthermore, the portions of Lor cited by the Examiner are devoid of such a teaching.

In particular, the Examiner cites paragraphs [0031], [0105] – [0106], and [0113] – [0117]. Paragraph [0031] describes an enterprise WLAN environment, that such environment includes WLAN switches, and functionality of such switches. However, paragraph [0031] is silent with respect to how and whether WLAN switches are selected.

Paragraphs [0105] – [0106] describe the manner in which load balancing may be performed on access points, including centralized and distributed approaches. However, similar to paragraph [0031], these paragraphs also are silent with respect to how and whether WLAN switches are selected. Paragraphs [0113] – [0117] describe additional details regarding load balancing. However, as noted above with respect to paragraphs [0031] and [0105] – [0106], these paragraphs are similarly devoid of any teaching or suggestion of selecting a subset of IPSGs, as required by Appellants' claim 1.

Accordingly, contrary to the Examiner's suggestion, Lor does not teach or suggest selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, as recited in Appellants' claim 1.

3. *Zargham fails to cure Lor's deficiencies.*

Contrary to the Examiner's assertion, Zargham does not teach or make obvious the computational relationships described in Appellants' claim 1. In particular, the Examiner states that Zargham, paragraph [0015], teaches that a profit for each customer equals weighted revenue less costs. However, this paragraph does not define a relationship between a revenue and costs or that a particular relationship between the two represents profit for a customer, as required by Appellants' claim 1. Rather, the cited paragraph merely mentions the terms "revenues" and "costs." Because the Examiner fails to explain why mere disclosure of the two terms makes a particular relationship between such terms obvious, a *prima facie* case of obviousness has not been established. Furthermore, claim 1 recites not just revenue, but "weighted revenue." Neither the cited portion of Zargham, nor the Examiner's argument even mentions such a limitation, and thus, a *prima facie* case of obviousness has not been established.

The Examiner further asserts that Zargham teaches that the cost per customer comprises a total bandwidth cost from the mobile access point (MAP) to customer premise equipment (CPE) and cost of provisioning an IPSG node. In particular, with respect to the total bandwidth, the Examiner alleges that Zargham teaches such an element because Zargham teaches aggregating information on costs, revenues, and bandwidth usage. Assuming that Zargham teaches aggregating information on bandwidth usage, such a teaching still falls short from defining the cost per customer as

including cost of bandwidth for a tunnel between two specific points, i.e., MAP and CPE, as required by Appellants' claim 1. The Examiner provides no explanation with respect to the gap between the two, and thus, a *prima facie* case of obviousness has not been established.

The Examiner also alleges that Zargham teaches that the cost per customer comprises the cost of provisioning an IPSG node because Zargham discloses using additional criteria to optimize traffic routing, such as quality of service, profit margin, bilateral agreements, available capacity, network looping, inter-carrier looping, and minimum and maximum number of selected routes). However, such criteria do not include the cost of provisioning an IPSG node and the Examiner fails to provide an explanation as to why using such a cost would be obvious. Rejections under 35 U.S.C. §103 require clear articulations of reasons why the claimed invention would have been obvious. Because the Examiner provides no reasons as to why including the cost of provisioning an IPSG into the cost per customer is obvious, a *prima facie* case of obviousness has not been established.

4. <u>*The Examiner's Assertion That The References Can Be Combined Or Modified Does Not Render The Resultant Combination Obvious Unless The Results Would Have Been Predictable To One Of Ordinary Skill In The Art: Examiner's burden not met.*</u>

The Examiner attempted to combine Lor and Zargham to produce the claimed subject matter, citing Zargam as providing the motivation to do so. However, "[t]he mere fact references can be combined or modified does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art." See MPEP §2143.01(III).

That is, assuming *arguendo* that a combination of Lor and Zargham somehow can be made, such a combination would fail to teach or suggest at least:

> "selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer

comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node," as recited in Appellants' claim 1.

This result is significant in two ways. First, it indicates that any predictable result or expectation of success for a combination of Lor and Zargham would most likely elude an artisan of ordinary skill in the art. Second, it further indicates that the Examiner failed to properly establish "any differences between the claimed subject matter and the prior art," which is one of the Graham factual inquiry or determination. *See KSR Int'l v. Teleflex, Inc.* 550 U.S. 398, 418, 82 U.S.P.Q. 2d 1385, 1396 (2007). Given their proper weight, the factual basis underlying the *Graham* factors inquiry clearly supports a finding of non-obviousness with respect to the claimed embodiments. Accordingly, the Examiner's burden in making factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966) is not met.

5. *Conclusion*

Appellants respectfully submit that there is no suggestion in Lor in view of Zargham that would have resulted in Appellants' invention as provided in independent claim 1.

A.2. Claim 11.

Claim 11 is rejected under 35 U.S.C. §103(a) as being unpatentable over Lor in view of Zargham. Appellants urge to the contrary.

As articulated above with respect to claim 1, Lor fails to teach all elements of independent claim 11 as required under 35 U.S.C. §103 for establishing a *prima facie* showing of obviousness. Independent claim 11 recites relevant limitations similar to those recited in independent claim 1 and, as such, independent claim 11 also is patentable under 35 U.S.C. §103(a) over Lor alone or combined with Zargham. Set forth below are additional reasons why claim 11 is patentable over Lor in view of Zargham.

1. *Specific Structure described in specification must be considered.*

Furthermore, claim 11 utilizes "means for" recitations, and as such requires the Examiner to consider the specific structure described in the specification (e.g., FIG.2) to

interpret these limitations. In particular, claim 11 recites means for selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node. Therefore, the "means for" limitation recited in the claimed embodiments cannot be broadly interpreted by the Examiner to read on the alleged implementation taught by Lord and/or Zargham. *In re Donaldson Co.*, 16 F.3d 1189, 29 USPQ2d 1845 (Fed. Cir. 1994). The structure disclosed by the Appellants cannot be disregarded. Because Lord in view of Zargham does not teach or suggest each and every element of claim 11, it does not render claim 11 obvious.

2. *Conclusion*

Appellants respectfully submit that there is no suggestion in Lord and Zargham that would have resulted in Appellants' claimed embodiments as provided in independent claim 11. As such, claim 11 is patentable under 35 U.S.C. §103(a).

A.3. Claim 22.

Claim 22 is rejected under 35 U.S.C. §103(a) as being unpatentable over Lor in view of Zargham. Appellants urge to the contrary.

As articulated above with respect to claim 1, Lor fails to teach all elements of independent claim 22 as required under 35 U.S.C. §103 for establishing a *prima facie* showing of obviousness. Independent claim 22 recites relevant limitations similar to those recited in independent claim 1 and, as such, independent claim 22 also is patentable under 35 U.S.C. §103(a) over Lor alone or combined with Zargham.

A.4. Claims 2-5, 10-15 and 21.

Claims 2-5, 10-15 and 21 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lor in view of Zargham. Appellants urge to the contrary.

This ground of rejection applies only to dependent claims, and is predicated on the validity of the rejection under 35 U.S.C. §103 given Lor and Zargham as applied to claims 1and 11 above.

As articulated above with respect to claims 1 and 11, there are missing claimed features not taught/suggested by the cited references – including:

> "<u>selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node,</u>" (emphasis added) – and

thus, dependent claims 2-5, 10-15 and 21 have been erroneously rejected under 35 U.S.C. §103(a). The Examiner failed to establish a *prima facie* showing of obviousness.

Therefore, Appellants' claims 2-5, 10-15 and 21 are patentable under 35 U.S.C. §103(a) over Lor alone or combined with Zargham as applied to claims 1and 11 above. Furthermore, with respect to claim claims 3 and 13, in addition to the reasons discussed above, a *prima facie* case of obviousness regarding claims 3 and 13 has not been established because Lor does not teach or suggest that the total bandwidth cost from the MAP to CPE includes dynamic bandwidth cost between MAP and IPSG and static bandwidth cost between IPSG and CPE.

More specifically, the Examiner asserts that such features are obvious because Lor discloses a load balancing manager examining two types of parameters in order to come up with a switching decision, i.e., static and dynamic parameters. Though Lor does disclose using two types of parameters and describes what those parameters are, teaching using such parameters to make a switching decision is entirely different from teaching that total bandwidth cost from a first point to a last point includes dynamic bandwidth cost from the first point to an intermediate point and static bandwidth cost from the intermediate point to the last point, as required by Appellants' claims 3 and 13. The Examiner fails to provide any explanation as to how the latter is obvious in the view of the former, and thus, a *prima facie* case of obviousness has not been established. Accordingly, claims 3 – 13 are allowable under 35 U.S.C. §103(a) over Lor in view of Zargham.

Conclusion

Thus, Appellants submit that all of the claims presently in the application are allowable.

For the reasons advanced above, Appellants respectfully urge that the rejection of claims 1-5, 11-15, 21 and 22 is improper. Reversal of the rejection of the Office Action is respectfully requested.

Respectfully submitted,

Dated: 10/14/09

E J Wall

Eamon J. Wall
Registration No. 39,414
Wall & Tong, L.L.P.
595 Shrewsbury Ave.
Shrewsbury, NJ 07702
Telephone: (732) 842-8110 x120
Facsimile: (732) 842-8388
Attorney for Appellant(s)

CLAIMS APPENDIX

1. (Previously Presented) A method, comprising:

identifying a set of virtual private network (VPN) customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one Internet Protocol (IP) service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each MAP is geographically remote from each IPSG; and

selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node.

2. (Original) The method of claim 1, wherein γ represents relative weight of revenue compared to total cost for customer l.

3. (Original) The method of claim 1, wherein said total tunnel bandwidth cost comprises a dynamic tunnel bandwidth cost between said MAP and said provisioned IPSG, and a static tunnel bandwidth cost between said provisioned IPSG and said CPE.

4. (Original) The method of claim 1, wherein only a single tunnel is established between said provisioned IPSG and said CPE, even during instances where traffic from multiple MAPs are going through said provisioned IPSG to reach said CPE.

5. (Original) The method of claim 1, wherein in an instance said provisioned IPSG sends traffic to more than one CPE, said provision cost is counted only once.

6. (Original) The method of claim 1, wherein said cost per customer l is determined by $C^l = \left(\sum_{i \in P, j \in Q} c^l_{ij} + \beta \sum_{j \in Q, k \in R_l} d^l_{jk} \right) + \alpha \sum_{j \in Q} f_j y^l_j$, where c^l_{ij} is a bandwidth cost associated

with sending traffic from a MAP node i to an IPSG node j, d^l_{jk} is a bandwidth cost associated with sending traffic from said IPSG node j to said CPE node k, β represents a weighing factor with respect to said shared static tunnel, f_j is a provisioning cost associated with using said IPSG node j , y^l_j is a binary variable denoting whether said IPSG j is provisioned for a provisioned customer to send traffic to at least one of its CPEs, and α is a weighing factor for provision cost over total bandwidth cost.

7. (Original) The method of claim 6, wherein said bandwidth cost (c^l_{ij}) associated with sending traffic from a MAP node i to an IPSG node j comprises the product of unit bandwidth cost (a_{ij}) between said MAP node i and said IPSG node j, and a sum of traffic $\left(\sum_{k \in R_l} s^l{}_{ijk}, \forall i \in P, \forall j \in Q\right)$ from MAP node i to said CPE node k that is directed through IPSG node j.

8. (Original) The method of claim 6, wherein said bandwidth cost (d^l_{jk}) associated with sending traffic from an IPSG node j to a CPE node k comprises the product of unit bandwidth cost (e^l_{jk}) between said IPSG node j and said CPE node k, and a total amount of traffic $\left(\sum_{i \in P} s^l{}_{ijk}, \forall j \in Q, \forall k \in R_l\right)$ from MAP node i to said CPE node k that is directed through IPSG node j.

9. (Original) The method of claim 6, wherein said total amount of traffic $\left(\sum_{k \in R_l} s^l{}_{ijk}\right)$ from MAP node i to said IPSG node j is less than or equal to total bandwidth capacity (g_{ij}) between said MAP node i and said IPSG node j.

10. (Original) The method of claim 6, wherein said total amount of traffic $\left(\sum_{i \in P} s^l{}_{ijk}\right)$ from said IPSG node j to said CPE node k is less than or equal to total bandwidth capacity (h^l_{jk}) between said IPSG node j and said CPE node k.

11. (Previously Presented) A virtual private network (VPN) system architecture, comprising:

means for identifying a set of virtual private network (VPN) customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one Internet Protocol (IP) service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each MAP is geographically remote from each IPSG; and

means for selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^l) equals weighted revenue (γV^l) less cost (C^l), ($U^l = \gamma V^l - C^l$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^l_C) from said MAP to said CPE, and a cost (C^l_V) of provisioning an IPSG node.

12. (Previously Presented) The system architecture of claim 11, wherein γ represents relative weight of revenue compared to total cost for customer l.

13. (Previously Presented) The system architecture of claim 11, wherein said total tunnel bandwidth cost comprises a dynamic tunnel bandwidth cost between said MAP and said provisioned IPSG, and a static tunnel bandwidth cost between said provisioned IPSG and said CPE.

14. (Previously Presented) The system architecture of claim 11, wherein only a single tunnel is established between said provisioned IPSG and said CPE, even during instances where traffic from multiple MAPs are going through said provisioned IPSG to reach said CPE.

15. (Previously Presented) The system architecture of claim 11, wherein in an instance said provisioned IPSG sends traffic to more than one CPE, said provision cost is counted only once.

16. (Previously Presented) The system architecture of claim 11, wherein said cost per customer l is determined by $C^l = \left(\sum_{i \in P, j \in Q} c^l{}_{ij} + \beta \sum_{j \in Q, k \in R_l} d^l{}_{jk} \right) + \alpha \sum_{j \in Q} f_j y^l{}_j$, where c^l_{ij} is a bandwidth cost associated with sending traffic from a MAP node i to an IPSG node j, d^l_{jk} is a bandwidth cost associated with sending traffic from said IPSG node j to said CPE node k, β represents a weighing factor with respect to said shared static tunnel, f_j is a provisioning cost associated with using said IPSG node, y^l_j is a binary variable denoting whether said IPSG j is provisioned for a provisioned customer to send traffic to at least one of its CPEs, and α is a weighing factor for provision cost over total bandwidth cost.

17. (Previously Presented) The system architecture of claim 16, wherein said bandwidth cost (c^l_{ij}) associated with sending traffic from a MAP node i to an IPSG node j comprises the product of unit bandwidth cost (a_{ij}) between said MAP node i and said IPSG node j, and a sum of traffic $\left(\sum_{k \in R_l} s^l{}_{ijk}, \forall i \in P, \forall j \in Q \right)$ from MAP node i to said CPE node k that is directed through IPSG node j.

18. (Previously Presented) The system architecture of claim 16, wherein said bandwidth cost (d^l_{jk}) associated with sending traffic from an IPSG node j to a CPE node k comprises the product of unit bandwidth cost (e^l_{jk}) between said IPSG node j and said CPE node k, and a total amount of traffic $\left(\sum_{i \in P} s^l{}_{ijk}, \forall j \in Q, \forall k \in R_l \right)$ from MAP node i to said CPE node k that is directed through IPSG node j.

19. (Previously Presented) The system architecture of claim 16, wherein said total amount of traffic $\left(\sum_{k \in R_l} s^l{}_{ijk} \right)$ from MAP node i to said IPSG node j is less than or equal to total bandwidth capacity (g_{ij}) between said MAP node i to said IPSG node j.

20. (Previously Presented) The system architecture of claim 16, wherein said total amount of traffic $\left(\sum_{i \in P} s^{l}_{ijk}\right)$ from said IPSG node j to said CPE node k is less than or equal to total bandwidth capacity (h^{l}_{jk}) between said IPSG node j and said CPE node k.

21. (Original) The system architecture of claim 11, wherein said MAPs provide dynamic switching and routing of data connections, while said IPSGs provide VPN services.

22. (Previously Presented) A computer readable medium for storing instructions that, when executed by a processor, perform a method for optimally provisioning connectivity for network-based mobile virtual private network (VPN) services, comprising:

identifying a set of virtual private network (VPN) customers, at least one mobile access point (MAP) and at least one customer premise equipment (CPE) associated with each VPN customer, and at least one Internet Protocol (IP) service gateway (IPSG) for facilitating VPN tunneling between a MAP and a CPE, wherein each said MAP is geographically remote from each said IPSG; and

selecting a subset of IPSGs to maximize total profit resulting from provisioning a subset of VPN customers on the selected IPSGs, wherein said total profit from all the customers comprises the sum of profits from each customer (l), where for each customer profit (U^{l}) equals weighted revenue (γV^{l}) less cost (C^{l}) ($U^{l} = \gamma V^{l} - C^{l}$), wherein said cost per customer comprises a total tunnel bandwidth cost (C^{l}_{C}) from said MAP to said CPE, and a cost (C^{l}_{V}) of provisioning an IPSG node.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.